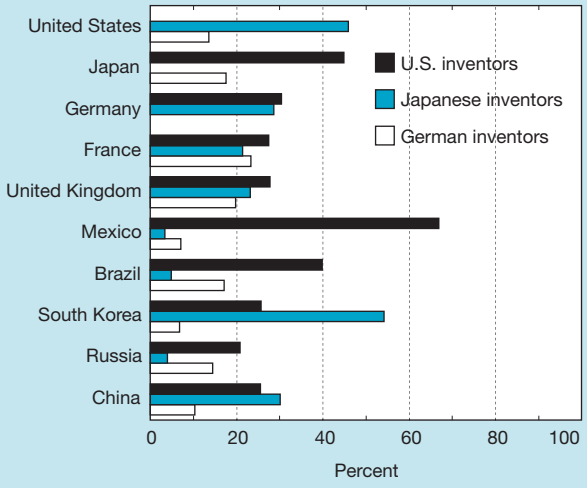
Text table 6-4.
Top 15 most emphasized U.S. patent classes for corporations from South Korea and Taiwan: 1999

South Korea	Taiwan
1. Transmission systems	Semiconductor device manufacturing process
2. Liquid crystal cells, elements and systems	Electrical connectors
3. Refrigeration	Solid state devices
4. Static information storage and retrieval	Music
5. Power delivery controls	Circuit makers and breakers
6. Television signal processing for recording	Substrate etching processes
7. Television	Receptacles
8. Semiconductor device manufacturing process	Electrical systems and devices
9. Dynamic magnetic information storage or retrieval	Chairs and seats
10. Electric heating	Computers
11. Miscellaneous active electrical nonlinear devices	Illumination
12. Electric lamp and discharge devices	Electrical power conversion systems
13. Electric lamp and discharge systems	Static information storage and retrieval
14. Active solid-state devices	Supports
15. Electric power conversion systems	Coded data generation

NOTE: Ranking is based on patenting activity of nongovernmental organizations, which are primarily corporations. Patenting by individuals and governments is excluded.

SOURCE: U.S. Patent and Trademark Office, Office of Information Services, TAF Program, 2001. *Science & Engineering Indicators – 2002*

Figure 6-27.
Patents granted to nonresident inventors in selected countries: 1998



See appendix table 6-14. *Science & Engineering Indicators – 2002*

International Patenting Trends in Two New Technology Areas[32]

This section explores the relative strength of America's inventiveness by examining international patenting patterns in two new technology areas: human DNA sequences and business methods. The analysis is built around the concept of a "patent family," i.e., all the patent documents published in a country associated with a single invention. See sidebar, "International Patent Families As a Basis for Comparison."

Three indicators are used here to compare national positions in each technology area:

- **Trends in international inventive activity.** This indicator is a preliminary measure of the extent and growth of inventive activity considered important enough to be patented outside the country of origin. These data are tabulated by priority year.
- **Number of organizations assigned patents.** The number of organizations in a country that are active in a technology may indicate a country's ability to innovate and its potential for innovative activity. Research by Michael Porter (1990) suggests that the growth of clusters of innovative organizations is associated with national competitiveness. The Council on Competitiveness (2001) also associates clusters of innovation with higher rates of innovation, productivity growth, and new business formation.
- **Highly cited inventions.** Interpatent citations are an accepted method of gauging the technological value or significance of different patents. These citations, provided by the patent examiner, indicate the "prior art" (the technology in related fields of invention) that is taken into account in judging the novelty of the present invention.[33] The number of citations a patent receives from later patents can serve as an indicator of its technical importance or value.

[32]Information presented in this section was developed by Mogee Research & Analysis Associates under contract to the National Science Foundation. (See Mogee April 2001 and Mogee June 2001).

[33]The citations counted are those placed on European Patent Office (EPO) patents by EPO examiners. EPO citations are believed to be a less biased and broader source of citations than those of PTO. See Claus and Higham (1982).

International Patent Families As a Basis for Comparison

A *patent family* consists of all the patent documents associated with a single invention that are published in one country. Although counting patent families gives a rough estimate of a nation's technological activity, international comparisons based solely on numbers of patent families can be misleading because differing national patent laws and customs can result in higher levels of patenting in some countries than in others. In addition, a patent generally offers protection only in the country in which it is issued; to protect an invention in multiple countries, multiple patent applications must be filed. Because it is extremely costly to pursue patent protection in multiple countries, organizations are assumed to seek patent protection abroad only for those inventions they believe will have significant commercial value. Patent families for which protection has been sought in more than one country are counted separately here and called *international patent families.* Counting international patent families makes international comparisons more accurate and theoretically provides a more precise measure of technological activity intended for international use.

Patents in a family are linked together through *priority* details. Priority is established by the application date assigned in the first country in which the invention was filed for protection. Under the Paris Convention, if the invention is filed in another convention country within one year of the original filing, the patent in the second country can claim the original priority. The country in which the priority application was filed is assumed to be the country in which the invention was developed. Similarly, the priority year is the year the priority application was filed.

This study was undertaken to provide data on the growth of patenting in these two technology areas, identify which groups are doing the patenting, and compare the position of the United States with that of other nations. The study examined patenting in more than 40 countries, including the United States, Japan, European countries, and other major industrialized and industrializing countries.

International Patenting of Human DNA Sequences

Whether human DNA sequences should be patentable has been strongly debated for many years.[34] Some have argued that patents on human DNA sequences are necessary to make diagnostic and therapeutic products commercially available. Others argue that giving companies monopoly rights over specific DNA sequences will hinder scientific progress.

Despite the ongoing controversies, patent offices worldwide have issued thousands of patents on human DNA sequences. As researchers move from mapping sequences to decoding their functions and manipulating them for diagnostic and therapeutic purposes, their work will transform the way many diseases are treated. The companies and countries that own key patents will benefit most from these developments. See sidebar, "Patenting of Human DNA Sequences: A Recent Invention."

Number of International Patent Families. Strong, steady growth in the number of international patent families in human DNA sequencing mirrors the growth in total patent families.[35] (See figure 6-28 and appendix table 6-15.) The United States accounts for a slightly higher share of international patent families (72 percent) than total families (69 percent). Overall, 75 percent of all U.S. patent families in this technology are international patent families. In contrast to the United States, only about 51 percent of Japan's total patent families are international patent families. As with total families, Great Britain ranks third in international patent families. China, which has 145 total patent families in this technology, has only 17 international patent families, possibly indicating that their patents are of lesser commercial value.

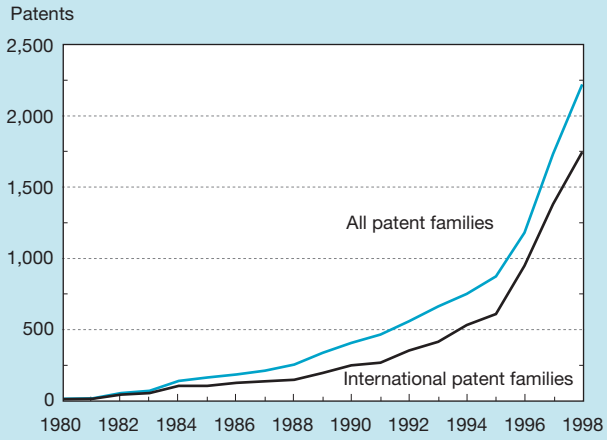
The United States appears to be the market of greatest interest to organizations patenting human DNA sequences, with protection being sought for more than 73 percent of all patented inventions in this field. (See text table 6-5.) Although most countries automatically publish patent applications 18 months after the priority application is filed, during the time period covered by this study, PTO published only granted patents, not applications. For this reason, there are probably additional patent families in this study for which protection

[34]Data on patents covering human DNA sequences were drawn from GENESEQ and the Derwent World Patents Index (DWPI), two on-line databases published by Derwent Publications. GENESEQ is the world's most comprehensive database devoted exclusively to patented sequence information, and each patent record in GENESEQ is reviewed and coded by molecular biologists at Derwent. Patents are included that claim DNA sequences or that refer to DNA sequences in their claims. A search was conducted in GENESEQ for all gene sequence patents that had been coded by the experts as relating to humans. GENESEQ records go back to 1981.

Each GENESEQ record corresponds to a patented sequence, rather than a patent, and gives only the basic patent number covering each sequence. Therefore, the basic patent numbers were mapped from the GENESEQ search into the DWPI, which covers patenting from more than 40 different countries and patent-granting authorities, to retrieve more complete patent family information. Each DWPI record constitutes a patent family, which avoids the problem of double counting inventions patented in more than one country. Using this procedure, 10,759 Derwent records were obtained, with 1980 as the earliest priority year.

[35]Because of the time lag between patent application and publication, data for 1999 should be considered incomplete.

Figure 6-28.
Human DNA sequence patent families worldwide: 1980–98



See appendix table 6-15. *Science & Engineering Indicators – 2002*

has been sought in the United States but for which no patent has yet been granted. Therefore, it is likely that the United States is undercounted in this table.

Europe and Japan also appear to be significant markets for organizations patenting human DNA sequences. Approximately half the patent families in this technology have protection in Europe, and protection has been sought in Japan for about 36 percent. Australia ranks fourth, with nearly 11 percent having sought protection in that country.[36]

Number of Organizations Assigned Patents. The number of technologically active organizations in a country may indicate that nation's current and potential level of innovation.

[36]If a Patent Cooperation Treaty (PCT) application lists Australia as a "designated state," Australia automatically publishes an Australian document, which the PCT applicant may not complete. To avoid spurious counts for protection in Australia, Australia was counted as a patent country only if the patent publication was a "B" (i.e., second stage) document or if no PCT application was on the record.

Text table 6-5.
Total number of patent families seeking patent protection in each country or region during 1980-99: Human DNA Sequences

Country/region	Patent families
Total families	10,759
United States	7,906
Europe	5,393
Japan	3,926
Australia	1,142
Canada	817
South Africa	637
Latin America	578
China	479
South Korea	460

SOURCE: "International Analysis of Human DNA Sequence Patenting," submitted to the National Science Foundation by Mogee Research and Analysis Associates (Reston, VA, April 10, 2001).

Science & Engineering Indicators – 2002

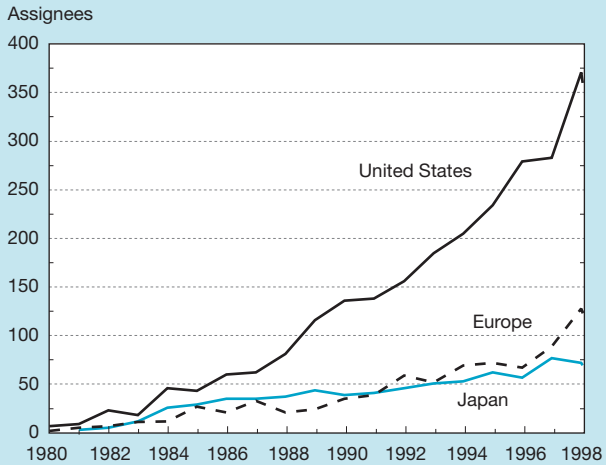
The United States has had the most organizations actively filing patent applications for human DNA sequences every year since 1980. (See figure 6-29 and appendix table 6-16.) Since 1995, the United States has consistently had 3 to 7 times the number of patenting organizations as Japan, which has ranked second every year since 1983. Great Britain has ranked third every year during that time period, except 1988. Although still quite low, patenting organizations in several countries, including Australia, China, Israel, Sweden, and South Korea, have increased significantly in number during the past few years.

Although corporations dominate human DNA patenting overall, the types of organizations actively patenting human DNA sequences vary among priority countries.[37] (See text table 6-6.) The majority of patenting organizations in Germany, France, Israel, and Japan are corporations; few universities, nonprofit organizations, or government agencies file priority applications in these countries. The United States and Great Britain have the largest number of universities seeking patents for human DNA sequences, although far more corporations than universities are active in these countries. Unlike the other major patenting countries, Australia, Canada, and China tend to have as many or more universities than corporations seeking patents for human DNA sequences.

Highly Cited Patents. The size of a country's share of the top-cited patent families is attributable partly to the technological significance of its patents and partly to the total number of patents it has. A country's share of the most highly cited patent families can be expressed as a ratio of its representation among highly cited patent families to its representation among

[37]As in appendix table 6-16, text table 6-6 shows the number of unique organizations filing patent applications, not the number of applications they have filed. In this table, individuals are included if no other type of organization was assigned the patent. If a company was assigned a patent and it was coassigned to the individual, the individual was assumed to be an employee of the company. If two organizations, such as a company and a university, were coassigned a patent, both were counted.

Figure 6-29.
Active assignees for DNA patents, United States, Japan, and Europe: 1980–98



See appendix table 6-16. *Science & Engineering Indicators – 2002*

Patenting of Human DNA Sequences: A Recent Invention

The patenting of genes and gene sequences has a relatively short history. The surge in patenting since 1990 has been fueled by the Human Genome Project, which has generated huge amounts of information on genes and gene fragments. In 2000, the Patent and Trademark Office (PTO) issued about 2,000 patents on full-length genes for all species. Reportedly, more than 3 million expressed sequence tabs (ESTs) and thousands of other partial and whole genes are included in pending patent applications in the United States. Some observers are concerned that patents on gene fragments, such as ESTs and single-nucleotide polymorphisms, might make the fragments unavailable to researchers or force researchers to negotiate a formidable web of licenses to work with the fragments. Such obstacles may hamper not only basic research but also research into cures for diseases.

The patentability of genes and gene sequences in the United States is based on the 1980 Supreme Court decision *Diamond* v. *Chakrabarty*, which ruled that genetically engineered living organisms could be patented. This decision was followed by internal actions by PTO in the mid-1980s that extended patentability to plants and nonhuman animals. In 1995, the U.S. Court of Appeals for the Federal Circuit affirmed that partially published sequences were patentable in a case *(In re Deuel)* used by PTO to support its policy of awarding patents for genes and gene sequences. PTO issued the first patent for an EST in October 1998 to InCyte Pharmaceuticals Inc.

Much of the research community was critical of patenting gene segments, especially when specific functions and applications were not known. Important research groups, such as the Human Genome Organization and the National Institutes of Health, argued that DNA patents should be granted only when specific applications are described or detailed information about the gene is supplied. In response to this criticism, PTO revised its examination guidelines on January 5, 2001. Under the new guidelines, an invention must be supported by "at least one specific, substantial, and credible or a well-established utility." This requirement may reduce the number of patent applications for genes or gene sequences.

In Europe, the European Union Council approved a directive on the legal protection of biotechnological invention in 1998 to harmonize and clarify the laws of the European nations and the European Patent Office. The directive states that a DNA sequence alone, without an indication of its function, is not patentable; the gene sequence must have an industrial application that is disclosed in the patent specification. If a gene sequence is used to produce a protein, the applicant must specify both the protein produced and the protein's function.

Until 1979, the Japanese Patent Office (JPO) took the position that microorganisms were not patentable because there were no industrial applications for them. In 1979, JPO reversed its position and issued a set of Working Standards on microorganisms. According to the Working Standards, DNA molecules were patentable, but patents were granted only to applicants who finished decoding procedures and could describe the DNA functions. In 1999, JPO announced that it would allow patents on DNA fragments if those fragments were shown to be effective for specific purposes, such as diagnosing or curing certain diseases.

Thus, three major patent offices have arrived at a consensus substantially in accord with that of the research community: that DNA fragments for which only sequence or alignment have been identified are not patentable. A DNA fragment is patentable only if it has a specific, useful application and if it meets the additional criteria that all patents must meet; that is, novelty, nonobviousness, and enablement.

the total families in a particular technology. (See text table 6-7.) A value of 1.0 indicates that a country's share of the highly cited families is identical to its share of total families; a value greater than 1.0 in the ratio column indicates that a country is overrepresented, while a score of less than 1.0 indicates that a country's patent families are undercited.

Although during the past 20 years the United States has had the largest number of highly cited patents in this technology by far, its total number of highly cited patents has been about what would be expected based on its overall level of patenting. Japan has been somewhat underrepresented among the most highly cited patents in each of the four time periods. One possible explanation for this is that about half of Japan's patent families are protected only in Japan, and examiners at the European Patent Office (EPO) may be less likely to cite such patents. Great Britain was significantly overrepresented among the most highly cited patents in the 1985–89 time period, but during the last two time periods, Great Britain's share of the most highly cited patents has been about what would be expected based on its level of activity. Germany had about twice as many highly cited patents as would be expected in the 1985–89 and 1990–94 time periods but fewer than would be expected during the last time period. Because these citations come from EPO, one might expect that EPO patents would be overrepresented; however, this occurred in only the 1990–94 time period. EPO priority patents were

Text table 6-6.
Active assignees, by priority country and period: Human DNA Sequences patents

Priority country	1980–84	1985–89	1990–94	1995–99
Australia				
Corporations	1	5	4	16
Universities	3	4	6	16
Not for profits	0	2	2	6
Government agencies	0	0	1	3
Individuals	0	0	0	1
Canada				
Corporations	1	3	2	8
Universities	1	2	4	13
Not for profits	0	0	0	0
Government agencies	0	0	1	0
Individuals	0	0	3	7
China				
Corporations	0	0	1	4
Universities	0	0	0	6
Not for profits	0	0	0	2
Government agencies	0	0	0	5
Individuals	0	0	0	5
Germany				
Corporations	4	9	14	33
Universities	0	0	3	9
Not for profits	0	0	4	8
Government agencies	0	0	1	5
Individuals	0	0	3	38
European Patent Office				
Corporations	1	12	12	40
Universities	1	2	1	16
Not for profits	1	1	2	11
Government agencies	0	1	3	3
Individuals	0	3	3	9
France				
Corporations	1	6	16	20
Universities	0	3	2	3
Not for profits	0	2	3	7
Government agencies	0	3	4	5
Individuals	0	0	10	0
Great Britain				
Corporations	10	29	45	63
Universities	2	0	18	27
Not for profits	3	1	7	9
Government agencies	0	1	8	4
Individuals	0	1	2	4
Israel				
Corporations	1	2	5	12
Universities	0	0	1	2
Not for profits	0	1	0	0
Government agencies	1	0	0	1
Individuals	0	0	0	0
Japan				
Corporations	27	65	93	117
Universities	3	6	2	0
Not for profits	2	4	6	7
Government agencies	1	5	6	9
Individuals	1	11	19	15
United States				
Corporations	52	116	241	412
Universities	13	53	108	163
Not for profits	7	23	48	59
Government agencies	1	7	13	20
Individuals	4	16	31	82

NOTE: Priority country is established by the location of the original patent application.

SOURCE: "International Analysis of Human DNA Sequence Patenting," submitted to the National Science Foundation by Mogee Research and Analysis Associates (Reston, VA, April 10, 2001).

Science & Engineering Indicators – 2002

Text table 6-7.
Priority countries ranked by share of top-cited patents: Human DNA Sequences

Priority country	Share of top cited (percent)	Share of total families (percent)	Ratio top cited to total families
1980–84			
United States	80.0	56.8	1.4
Great Britain	10.0	10.1	1.0
Japan	10.0	23.6	0.4
1985–89			
United States	62.3	61.6	1.0
Japan	16.4	23.2	0.7
Great Britain	8.2	4.8	1.7
Germany	3.3	1.8	1.8
Denmark	2.5	0.9	2.8
France	2.5	2.1	1.2
European Patent Office	1.6	2.1	0.8
Israel	1.6	0.8	2.0
Netherlands	0.8	0.5	1.6
Sweden	0.8	0.3	2.7
1990–94			
United States	69.8	71.9	1.0
Japan	10.8	14.1	0.8
Great Britain	4.7	4.2	1.1
Germany	4.3	2.2	2.0
European Patent Office	2.6	1.4	1.9
France	2.6	1.9	1.4
Australia	1.3	0.7	1.9
Denmark	1.3	0.7	1.9
Israel	1.3	2.0	0.7
Canada	0.9	2.6	0.3
Italy	0.4	1.0	0.4
1995–99			
United States	76.8	70.3	1.1
Japan	9.8	11.0	0.9
Great Britain	4.8	5.0	1.0
European Patent Office	2.7	2.8	1.0
Germany	2.1	3.2	0.7
Australia	1.8	1.2	1.5
France	1.2	1.3	0.9
Canada	0.3	0.8	0.4
Denmark	0.3	0.3	1.0
Israel	0.3	0.4	0.8

NOTE: Priority country is established by the location of the original patent application.

SOURCE: "International Analysis of Human DNA Sequence Patenting," submitted to the National Science Foundation by Mogee Research and Analysis Associates (Reston, VA, April 10, 2001).

Science & Engineering Indicators – 2002

underrepresented among the most highly cited in the 1985–89 time period and are about what would be expected in the 1995–99 time period. Care should be taken not to read too much into the ratios for countries with low levels of activity because one or two highly cited patents from these countries may make them appear to be overrepresented among the highly cited families.

International Patenting of Internet-Related Business Methods

During the 1990s, the Internet spurred the development of new methods to conduct business, and growing numbers of companies sought patent protection for these new business models.[38] The patenting of Internet business methods has been nearly as controversial as the patenting of human DNA sequences. See sidebar, "Patenting of Internet Business Methods in the United States, Japan, and Europe."

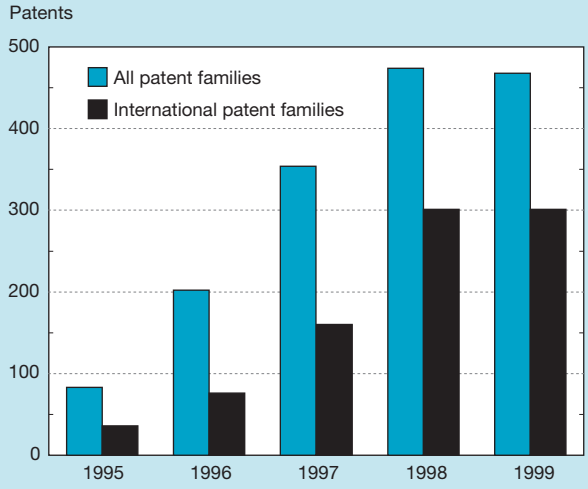
This section examines the growth of patenting of Internet business methods, which nations are doing the patenting, and the position of the United States in global patenting. The data include recent patenting trends in more than 40 countries, although the section focuses primarily on the major actors in this field, the United States, Japan, and Europe.

Number of International Patent Families. Strong, steady growth in the number of international patent families in this technology mirrors the growth in total patent families.[39] (See figure 6-30 and appendix table 6-17.) The United States accounts for a significantly higher share of international patent families (72 percent) than total families (50 percent). Overall, 78 percent of all U.S. patent families in this technology are international patent families. Japan ranks second in international families (7 percent). However, in contrast with the United States, only about 15 percent of all Japanese patent families are international patent families. Great Britain ranks third in international patent families (3.5 percent), followed by Germany (2.2 percent).

The United States appears to be the market of greatest interest to organizations patenting Internet business methods, which sought protection there for more than 52 percent of all patented inventions in this field.[40] (See text table 6-8.) Although most countries automatically publish patent applications 18 months after the priority application is filed, during the time period covered by this study, PTO published only granted patents, not applications; therefore, the United States is probably underrepresented in text table 6-8.

Japan and Europe also appear to be markets of significant interest to organizations patenting Internet business methods. One-third of the patent families in this technology have protection in Japan, and protection has been sought in Europe for fewer than one-third. Canada ranks fourth; only about 6 percent of patent families have protection in that country.

Figure 6-30.
Internet-related business method patent families worldwide



See appendix table 6-17. *Science & Engineering Indicators – 2002*

Text table 6-8.
Total number of patent families seeking patent protection in each country or region during 1980-99: Internet-related business methods

Country/Region	Patent families
United States	847
Japan	530
Europe	505
Canada	90
China	68
South Korea	67
Australia	61
Latin America	49
Taiwan	21
South Africa	15
Israel	14
New Zealand	6
Other	24

SOURCE: "International Analysis of Internet-Related Business Methods Patenting," submitted to National Science Foundation by Mogee Research and Analysis Associates (Reston, VA, June 7, 2001).

Science & Engineering Indicators – 2002

[38]Data for this section were drawn from DWPI, which covers patenting from more than 40 different countries and patent-granting authorities. Each DWPI record constitutes a patent family, thus avoiding the problem of double counting inventions that are patented in more than one country.

DWPI began comprehensive coverage of Japanese patenting in this technology area in 1996. Therefore, the search was limited to records with an earliest priority year of 1995. (Most priority applications filed in 1995 would not be published, and hence appear in the database, until 1996 or later. Priority applications filed before 1995 could be published before 1996 and consequently miss some Japanese patents.)

The set of Internet-related business method patent families was formed from the intersection of the set of business method patents with the set of Internet patents. Only the records with priority years from 1995 through the present were selected for this analysis.

[39]Because of the time lag between patent application and publication, data for 1999 and 2000 should be regarded as incomplete.

[40]Any family with either an EPO patent or a patent in any European country was counted as having protection in Europe. Only the top countries and regions (those where protection has been sought for more than five total patent families) are presented in text table 6-8. "Latin America" refers to patents filed in Mexico, Brazil, or Argentina.

Patenting of Internet Business Methods in the United States, Japan, and Europe

Patent applications worldwide for methods of conducting business on the Internet grew rapidly in the late 1990s. Because business methods and algorithms were not considered patentable in the United States, Europe, or Japan, these applications quickly became controversial.

In the United States, business methods were excluded from patentability based on a series of court decisions beginning in the early 20th century. The Court of Appeals of the Federal Circuit struck down these exclusions in *State Street Bank & Trust Co. v. Signature Financial Group, Inc.* (1998) and *AT&T Corp.* v. *Excel Communications* (1999). As a result of these two cases, software or software-enabled inventions are considered patentable if they can be shown to have a practical application. According to some observers, these decisions left open the possibility that "pure" business methods (i.e., those without hard technology, such as computers), are patentable.

The ensuing surge in patent applications for business methods led to high-profile patent litigation cases and fueled a debate over whether business methods should be patentable at all, and, if so, whether business methods that are merely computerized versions of known business techniques or do not involve hard technology should be patentable. Behind these questions lurked the perennial disagreement over whether patents in general, and these patents in particular, help or hurt innovation.

A related issue was whether patents for business methods being granted by the Patent and Trademark Office (PTO) met the general criteria of novelty, utility, and nonobviousness. Critics accused PTO of granting patents for business methods that were obvious or overly broad. PTO responded by hiring examiners with expertise in business practices, improving search methods and resources, and expanding quality review sampling.

Congress contributed to the debate by including provisions in the 1999 American Inventors Protection Act to protect companies using business methods they did not believe were patentable that were later patented by another company. In 2000, the Business Method Patent Improvement Act (H.R. 5364) was introduced in the House of Representatives to make these patents more difficult to obtain and easier to challenge. The bill covers patents for both software- and nonsoftware-enabled business methods. The bill did not pass in 2000 but was reintroduced as H.R. 1333 in 2001.

The European Patent Office (EPO) as well as many European national patent offices formally exclude patents for software and business methods. Article 52(2) of the European Patent Convention expressly excludes software and business methods from the list of patentable inventions. This exclusion has had little practical effect on software inventions because a product or method that is of "technical character" may be patentable even if it involves software. Because determining "technical effect" is difficult, EPO has granted very few business method patents.

In late 2000, EPO changed its practice regarding business methods patents after a decision by the Board of Appeal. In a case involving IBM, the Board stated: "a computer program product is not excluded from patentability if, when run on a computer, it produces a 'technical effect' that goes beyond the normal physical interactions between program and computer." Despite the change in EPO practice, a November 2000 Diplomatic Conference to revise the European Patent Convention failed to delete the exclusion on software patenting, reflecting the disagreement remaining in Europe on this issue.

In December 2000, the Japanese Patent Office (JPO) published new policies and examination standards on patenting of algorithms and business methods that use algorithms. Previously, JPO excluded inventions classified as mathematical algorithms, natural laws, mathematical expressions of natural laws, or inventions that result in "mere processing of information by a computer" unless the application showed how the invention used the computer's resources in the processing. Current JPO policy considers most business methods inventions as forms of software inventions: "An invention, whether it is business-related or not, can be subject to a patent as a software-related invention if it meets certain requirements, such as involving information processing that uses computer hardware resources in order to solve a problem." Pure business methods per se, however, are not patentable: "The systematization of existing human transactions shall be deemed as not involving an inventive step and thus lack patentability, if it can be realized by routine application of usual system analysis and system design technologies, since it would be within the exercise of ordinary creative ability expected of a person skilled in the art to which the invention pertains."

In June 2000, the members of the Trilateral Patent Offices (PTO, EPO, and JPO) released a comparative examination of hypothetical computer-implemented business method patent claims. Despite the differences in their systems, the offices tended to make the same judgment on whether an application should be patented. The report concluded that a technical aspect is necessary for a computer-related business method to be eligible for patenting. EPO and JPO require that this technical aspect, typically a computer-related aspect, be expressed in the claim, whereas PTO allows it to be implicitly in the claim. The offices also confirmed that mere automation of a business process that had been known as a manual process, by way of using a well-known automation method, is not considered patentable. Thus, although the rules governing patenting of Internet business methods in the United States, Japan, and Europe are beginning to converge, important differences remain.

Number of Organizations Assigned Patents. The number of organizations in a country that are active in a technology may indicate that country's level of technological capability.[41]

Every year since 1995, the United States has had the most organizations actively filing patent applications for Internet business methods. (See figure 6-31 and appendix table 6-18.) During 1997–99, the United States averaged between 100 and 200 active assignees per year, two to four times the number of patenting organizations as Japan, which has ranked second in the number of active patenting organizations every year since 1995 and now has about 50 organizations per year filing priority applications in this technology. Trailing well behind are Germany, Great Britain, and Australia; these countries have between 3 and 10 organizations filing priority applications each year.

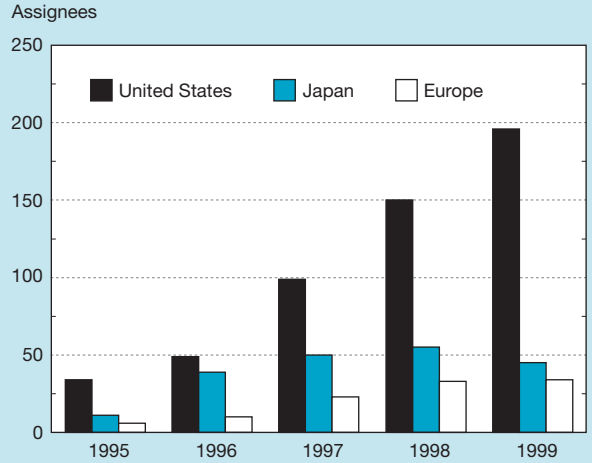
Text table 6-9 shows that in every country covered by this study, almost all the assignees are corporations or individual inventors. The United States is the only country in which universities consistently patent Internet business methods.[42] South Korea and Japan show occasional patenting activity from government agencies in this field. EPO, Finland, and Sweden show less activity from individuals than the other patent offices covered.

Highly Cited Patents. Since 1995, the United States has accounted for about 50 percent of all patent families for Internet business methods but more than 71 percent of the highly cited patent families. (See text table 6-10.) Thus, the United States has about 40 percent more of the highly cited patents in this field than one would expect based on its overall level of activity. This indicates not only that the United States is generating large numbers of patents in this field but also that these patents have technological significance for those inventions that follow. Unlike the United States, Japan has been significantly underrepresented among the most highly cited patents in this technology relative to its overall level of activity. Although Japan accounts for about 27 percent of all patent families, it accounts for only 6.8 percent of the cited families. One possible explanation for this is that about 85 percent of Japan's patent families are protected only in Japan, and such patents may be less likely to be cited by EPO examiners. Among the other countries that account for at least 2 percent of total patent families in this technology, Germany is significantly overrepresented among the cited patent families with about 50 percent more cited families than would be expected based on its overall level of patenting activity. Canada is significantly underrepresented among the cited patents, and Great Britain has about the number of cited patents expected based on its overall level of activity in this field. Care should be taken not to read too much into the ratios for countries with low levels of activity because one or two highly cited patents from these countries may make them appear to be overrepresented among the highly cited families.

[41]This refers to the number of unique organizations that have filed patent applications, not the number of applications they have filed. Data for 1999 and 2000 should be considered incomplete because of the 18-month time lag between the date a patent application is filed and the date it is published.

[42]Like those presented for human DNA sequence patents discussed earlier, data reflect the number of unique organizations filing patent applications, not the number of applications they have filed. Individuals are counted only if no other type of organization also was on the patent.

Figure 6-31.
Active assignees for Internet-related business methods patents, United States, Japan, and Europe



See appendix table 6-18. *Science & Engineering Indicators – 2002*

Venture Capital and High-Technology Enterprise

One of the most serious challenges to new entrepreneurs is capital, or the lack thereof. Venture capitalists typically make investments in small, young companies that may not have access to public or credit-oriented institutional funding. Venture capital investments can be long term and high risk, and they may include hands-on involvement in the firm by the venture capitalist. Venture capital can aid the growth of promising small companies and facilitate the introduction of new products and technologies, and it is an important source of funds for the formation and expansion of small high-technology companies. This section examines investments made by U.S. venture capital firms by stage of financing and by technology area.

The latest data show total venture capital under management rising vigorously each year from 1996 through 2000. The largest one-year increase occurred in 1999, when the pool of venture capital jumped to nearly $145.2 billion, a 72.5 percent gain from the previous year. In 2000, once again, the pool of venture capital grew sharply, rising 60.9 percent to $233.7 billion, more than six times the amount managed only five years earlier.[43]

The amount of capital managed by venture capital firms grew dramatically during the 1980s as venture capital emerged as an important source of financing for small, innovative firms. (See text table 6-11.) By 1989, the capital managed by venture capital firms totaled nearly $33.5 billion, up from almost $4.1 billion in 1980. The number of venture capital firms also grew

[43]According to a recent report from the National Venture Capital Association (2001), new money coming into venture capital funds slowed down during the last quarter of 2000 following several quarters of lackluster returns to investors in venture captial funds.